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Raymond C. Backstrom
The University of Montana

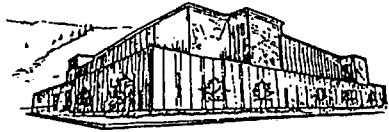
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EXPLORING THE POTENTIAL OF
GEOGRAPHIC INFORMATION SYSTEMS
TO CONVEY THE
HISTORICAL GEOGRAPHY OF BATTLEFIELDS
(AN IWO JIMA EXAMPLE)

By

Raymond C Backstrom

B.A. University of Montana, 1995

presented in partial fulfillment of the requirements

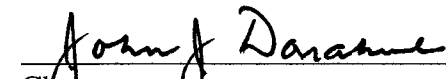

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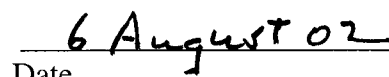
MASTER OF ARTS

The University of Montana

2002

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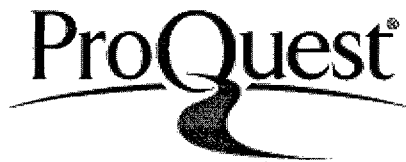
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ABSTRACT

Raymond C Backstrom, MA 2000

Geography

Exploring the Potential of Geographic Information Systems to Convey the Historical Geography of Battlefields (An Iwo Jima Example)

Director: John J Donahue Ph. D. JD .

Geographic Information Systems (GIS) prove to be valuable tools for managing large quantities of geographically referenced information. They are commonly used by local, state, and federal agencies, along with private companies to access and manage immense data sets. This technology has yet to be embraced by military historians to re-create the historical geography of battlefields despite the fact that battles have been well documented with maps dating back to at least the American Civil War. The military and national archives hold vast volumes of data that can be geographically and digitally referenced to allow easy storage, retrieval, and output to an appropriate medium. By incorporating such data into digital atlases, these records can be made portable and can be easily distributed.

Using a GIS streamlines atlas construction. By changing a few lines of code in the ArcInfo Macro Language (AML) written to create the Atlas, a new set of maps can be computer-generated by re-running the AML. This ensures exact replication of features from map to map.

To provide an example, I have prepared an interactive digital atlas using GIS. Its theme relates to the U. S. Marine landing on, and subsequent battle for, the Pacific island of Iwo Jima, during 19 February - 26 March 1945. In completing the digital atlas I consolidated data from the following sources: 39 after-action reports, 3 studies, 45 maps, and numerous illustrations from the after-action and daily progress reports. To my knowledge, no other documentation of any historic military battle presents as many actual reports and maps as have been incorporated into this Iwo Jima interactive digital atlas. This interactive digital atlas requires the purchase of no proprietary software and it runs on software available on all new microcomputers, or provided free over the Internet.

The Iwo Jima interactive digital atlas provides an example of battlefield reconstruction that is in tune with today's technology. It demonstrates that GIS has the capacity to carry battlefield historical geography forward into the technology of tomorrow. And in so doing, it attains a level of detail expressed in the words of those who fought there.

PREFACE

Atlases have been used to convey geographic information for centuries. For most of this time their format has remained basically the same, being that of a map folio. As recently as 1907¹ the US Government was still publishing atlases in folio format. Today digital map atlases transmitted over the Internet are nothing more than collections of digitally copied maps. The only advantage these collections offer over traditional atlases published nearly 100 years ago is Internet access.

Until now, recently produced digital atlases barely hint at the potential inherent in Geographic Information Systems technology. I believe that this technology offers an ideal mechanism for combining different kinds of historical battlefield information into a new digital atlas type ... an interactive digital atlas.

Using GIS technology I have prepared an interactive digital atlas covering the U. S. Marine battle for the Pacific Island of Iwo Jima in 1945. A compact disk (CD) copy of the atlas is available in the back pocket of this text. The atlas has photographic and textual information attached to the various map points, lines, and polygons representing ground elements in the battle for the island. I believe this atlas demonstrates the potential of GIS to produce expressive interactive digital atlases focused on the historical geography of military battlefields. The Iwo Jima interactive digital atlas on the appended CD illustrates but one-way of representing this geography. This interactive digital atlas will allow anyone anywhere in the world to access the details of this historic battle in the very maps, images, words and photographs of those who fought there.

¹ The US Geological Service published folios of the National Forests during this time frame. Each folio contained maps of individual townships within the forest represented.

ACKNOWLEDGEMENTS

I want to express my sincere appreciation to my advisor Dr. John J. Donahue, and my other committee members, Dr. Jeffery Gritzner and Dr Thomas A. Foor, for their encouragement in this project. In addition I need to thank the three institutions that truly made this work possible by providing source materials for the atlas. The first is the Marine Corps Museum, Washington Navy Yard, in Washington DC for providing me with access to their maps and records. The second is the Marine Corps University, Marine Corps Combat Development and Education Center at Quantico, Virginia for the thousands of pages of documents they copied and mailed to me. The third is the US Army Military History Institute in Carlisle, Pennsylvania. Without these three institutions, my research would have been impossible.

I need to express special appreciation to my wife, Mary, for her initial and sustaining encouragement, love, and understanding throughout this undertaking, and for enduring all the late nights.

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CHAPTER 1

1. Nature and Scope of the Atlas Problem

For the last 50 years or more, authors have written many generalized accounts about the battles of World War II (WW II). Because they were reproduced on paper (printed books, maps, and photographs) these publications could not be readily transmitted to and viewed by anyone anywhere in the world. In consequence, no more than a small portion of the details available on a particular battle have come to light. And very few individuals have sufficient financial or other means to gain access to the original records to bring them to light. In consequence, most details of these battles have remained hidden. Only broad accounts are available to individuals lacking access to the national or military archives.

Currently there is no easy or cheap way of accessing a vast amount of geographic information generated to document military battles involving U.S. troops. Individual service branches have documented many battles of the last half-century in great detail; however, this information resides in records resting in rather forbidding government mausoleums such as the National Archives or military archives such as the Marine Corps Museum in the Washington Navy Yard.

Even where paper atlases have been converted into digital form, they convey no more information than is conveyed by their traditional book counterparts. The digital versions are merely unimproved copies of the paper originals. Published digital atlases lack the dynamic capacity to interactively provide access to the immense volumes of information available on our historic battles. By tapping the capabilities of a GIS we can capture and disseminate any type of information ever produced on any historic battle in

the form of an interactive digital atlas. In doing so this vast volume of information becomes readily accessible to anyone, anywhere that owns or has access to a Personal Computer (PC).

1.1 The Purpose of the Study

The purpose of this study is to document and discuss the creation of the first interactive digital atlas of a historical battlefield site in a way that is objective and integrates many attributes or characteristics of the battlefield on instant demand by viewers. The Iwo Jima interactive digital atlas will provide for future generations the geographical progress of this pivotal battle long after all those who fought it are gone. I trust that this atlas will provide a prototype for other interactive digital atlases to come.

In creating the Iwo Jima interactive digital atlas, I hope to demonstrate one practical solution to the problem of making facsimiles of historic military records widely accessible to everyone, everywhere in the world. Perhaps even more importantly, these military records are integrated into a geographical framework. Viewers can go to different map locations within the study area and instantly call up records, including narratives and photos, of the spatial content at the time of battle. This Iwo Jima interactive digital atlas far exceeds in amount of presented detail and ease of access any current digital or hard copy product devoted to any major battle.

1.2 Accomplished Objectives

In the process of completing this thesis, I:

- (1) - Created a Geographic Information System (GIS) on the battle of Iwo

Jima. In doing so, I took the following steps:

- a. I identified, located, and acquired copies of the original records on the battle of Iwo Jima.
- b. I digitized the map data, and converted the digital map data to a common projection (UTM zone 54).
- c. I typed the textual descriptions of the battle of Iwo Jima.
- d. I scanned in photographic records of the battle.
- e. I combined these digital records into a GIS

(2) - Using the generated GIS, I prepared a series of interactive atlas sheets, which allow users to access different levels of information on the Battle of Iwo Jima. The interface of this interactive digital atlas allows users with a click of a mouse to change from viewing division level written reports to regimental or battalion level written reports. These textual accounts of the battle are included to give the researcher a first hand account of what transpired on any given day with any of the individual units, or at a specific location.

(3) – I combined these atlas sheets along with the other data into a single interface equipped with the navigation tools required to view all information over the Internet or on a CD-ROM.

(4) – I demonstrated, with examples, the usage, advantages, and disadvantages inherent in a prototype interactive digital battlefield atlas.

1.3 Advantages of Current GIS Technology

When obtaining information about a historic battlefield, researchers must start with source materials in their available form. Prior to the inception of GIS, the option of combining, analyzing, and outputting data to give an integrated view of the events was

virtually non-existent. GIS offers the capability to create the most informative combinations of source materials, a capability which provides a most useful tool for military archivists, historians and researchers.

Current technology allows the compilation of historic maps and overlays into digital format so that they can, in effect, be overlaid on one another to produce detailed and accurate composite maps. Such overlays can be used to reconstruct the geography of any historic battlefield where adequate records exist. When integrated with textual and photographic accounts, digital composite maps offer a new approach to presenting the geography of battlefields. The approach involves hyper-linking from the map sheet to photographs and HTML pages, not just viewing a digital map sheet, steps that in combination generate noteworthy improvements over traditional atlas sheets. The resulting atlas sheets are interactive and dynamic and should provide considerable information to many scholars, researchers, and lay people.

1.4 Why Make a Digital Atlas?

I chose to make a digital atlas for lack of an alternative cost-effective or efficient method of disseminating battle records, particularly those of Iwo Jima, as they are currently archived. In their present format these records are costly to reproduce and cumbersome to organize. For every individual who requests copies of battlefield records the paper originals must be copied or scanned and mailed.

GIS provides a cheaper and much more flexible way to replicate and organize records of historic battles. However, each GIS software package uses unique file formats. To access these files requires the purchase and mastery of expensive proprietary

software. These difficulties render proprietary GIS software largely unsuitable for the distribution of GIS digital data to the general public. In order to be easily distributed, commercial GIS formats must be converted to file formats that can be read by software provided at no cost such as comes on new PC's or downloaded for nothing on the Internet. Once converted, these files can then be consolidated with other digital files to produce a digital atlas. This approach seems to provide the only inexpensive and practical solution to disseminating historic military records.

1.5 Nature and Scope of Military Source Documents

United States national and military archives hold documents that address virtually every aspect of many recorded battles. They contain initial documents defining an operation's objectives, its planning, various updates of operational maps that detail intelligence current at publication, detailed landing plans, and summaries giving battle particulars and progress for each day of the operation. After each battle, vast numbers of documents were created that detailed what worked, what did not, and what the actual enemy situation was in comparison to what it was thought to be before entering the battle. It would take months or years, depending on the combat operation under study, to acquire and compile these documents into coherent, logical sequences. In their original form and current state of organization, such military reports of battles are difficult to access within the archives and virtually impossible to transfer outside archive walls. Digital access to these records could provide insights into many historic battles that could never be envisioned before.

1.6 Challenges in Obtaining and Disseminating Military Source Documents

Because many battle records are un-cataloged, the first obstacle to overcome lies in the identification of where they are stored and what is their accessibility. Initially I had a few successes and a few false starts in locating records concerning the battle of Iwo Jima. Eventually I identified four reliable record sources. The first two repositories, the National Archives and the Marine Corps Museum were intuitively evident, but the second two, less intuitive, ultimately proved to be more valuable. The Marine Corps University at Quantico, Virginia, provided me with an extremely high number of photocopies of all unit after-action reports. The Army's Military History Institute in Carlisle, Pennsylvania provided me with two original documents containing maps, which allowed me to reconstruct the Japanese defenses on Iwo Jima, and photos of these defenses.

Once acquired, the copies of the source documents still cannot be easily distributed as a record of this historic battle. Dissemination of these documents in their original paper form would be costly and impractical. When copied for distribution, the copied documents would constitute just a tall stack of documents, maps, and overlays. Recipients would have to cull through them and put them in some conceptual order in order to digest their contents. If organized and forwarded to another interested party, the receiving individual must then reorganize the documents to clearly portray what aspect he or she was interested in. This duplication of effort would have to be undertaken by each new recipient.

1.7 Who Seeks Such Atlas Information?

Access to battlefield records has usually proven difficult for individuals seeking information on the roles that their relatives or friends played in the different wars our country has fought. Since I started putting the information about the battle for Iwo Jima on the Internet in August 2000, I have received considerable feedback from many who landed on my web site. These people tell how they are searching for more information on their fathers, grandfathers, uncles, or great uncles. They tell of the trials their relatives endured during their time on Iwo Jima. One stated that his father on coming back from WW II, burned his uniforms and didn't speak one word about his time on Iwo Jima to the day he died; another searcher's father was killed in action on Iwo Jima. Since creating this website, the front page has provided in excess of 65,000+ page views, while the complete site is currently at 170,000+ page views.

Unfortunately individuals seeking information on other battles find very little of worth. What is readily available over the Internet is quite meager because most sites consist of personal accounts or are lead-ins to lure viewers to purchase books. Very few sites provide many actual service branch records of their respective battle. Even with the technology available today to present the facts and impressions of other battles as recorded by the participants, nothing of substance has yet appeared. In this context, my Iwo Jima interactive digital atlas stands unique in its potential to inform the public about a specific battle, and it models which elements to incorporate into a digital battlefield atlas.

1.8 **Why the Battle of Iwo Jima?**

I chose the battle of Iwo Jima as the subject of this interactive digital atlas because of a trip I made to the island in February 1992. Despite an extensive search for geographic and other sources of information prior to the trip, I failed to locate enough detailed information to adequately study the battle site during my three-day visit. As a result, although informative and enjoyable, the trip turned out to be a hit-and-miss attempt to understand the battle for the island. As a result, I was unable to grasp this battle at a level of detail that it deserved and that I had hoped for. Having access to the information now contained in the interactive digital atlas would have allowed me, and presumably the many hundreds who have since traveled to Iwo Jima, to plan and spend our time on the island in a much more efficient and productive manner.

1.9 **Literature Review Problem**

Although intensive efforts were made to find research devoted to the preparation of a digital atlas, I found nothing of value in print or electronic format. While there were plenty of paper atlases on a wide variety of topics, none showed the amount of detail on historic battles that I envisioned. What I found in digital format were simply collections of low-resolution scans of paper maps, and digital maps in Adobe Portable Document Format (PDF) format. Those that were in PDF format usually were created for distribution as single files, but none again contained the detail I sought. They were simply collections of unrelated or un-integrated maps in PDF format.

Outside of the procedural instructions found in ArcInfo help files, I found nothing that offered any guidance in creating the maps or any help on format, content,

preparation, navigation, or linkage of the digital files together in an interactive digital atlas.

What I eventually found were several unrelated software packages that generated output having the potential for inclusion in a digital atlas.

1.10 Advantages of a Digital Atlas

The advantages of the Iwo Jima Digital Atlas can be broken down into two areas: construction and publishing.

1.10.1 Construction

There is no longer reason to compare digital cartography to the days of ink, scribe sheets, and stickup. These older methods are not as efficient as modern computer cartographic processes. If they were, they would still be in common use. But they are not. The manual methods of making maps just do not offer the flexibility or ease of computer methods, and I consider them hopelessly obsolete.

1.10.2 Publishing

There are two media for publishing a digital atlas, publishing over the Internet and publishing on CD-ROM.

(a) Publishing over the Internet - Many Internet providers offer free web space in exchange for placing ads on web sites. This makes the cost of publishing over the Internet free. However, space and volume of downloads from visitors are limited. I am currently limited to 15 Mb of web space, and because of the number of visitors I get, my web site is regularly shut down for exceeding the data download limits. Even with paid web space, space considerations would still limit the amount of data that can be made available over the Internet. While this method of publishing is inexpensive, its major asset is that these data are available 24 hours a day, 7 days a week to anyone anywhere in the world.

(b) Publishing on a CD-ROM – When publication is by means of CD-ROMs, short runs (printing small quantities) become very affordable. The process can be as simple as producing the CD-ROMs on a home PC on one end to, alternatively, printing sleeves for the CD jewel cases, printing labels on and writing the CD-ROMs commercially. Depending on the number of copies made, this method of publishing can be much cheaper than printing a paper counterpart. The biggest advantage to publishing a digital atlas on a CD-ROM is the capacity to present a large volume of information in a compact media that can be easily accessible to anyone with a PC.

The digital atlas can be disseminated over the Internet, supplemented by additional access through e-mail, mail, and placed into the public library system. Once published this formerly unavailable information could be available to anyone anywhere.

1.11 Problems Inherent in the Iwo Jima Interactive Digital Atlas

I recognize only two significant problems inherent in the Iwo Jima interactive digital atlas. They involve space limitations on both the CD-ROM's and the Internet as well as slow Internet download speeds.

While CD-ROM's are currently the computer industry's standard for distributing software, space limitations on the CD-ROM restrict how much information can be provided. Designing digital atlases to span multiple CD-ROM's can circumvent the space limitations. DVD technology will eventually turn this into a non-problem.

When the DVD readers become commonplace the capabilities will expand far

beyond anything possible now. With DVD storage reaching up to 17 Gb of information, a digital atlas prepared on a DVD can contain the equivalent of 26.5 CD-ROMS. With that much storage space available, every map ever produced on a historic battle, all the documents written about the battle, and probably every combination of information derivable from a GIS devoted to the battle could be distributed on a single DVD.

When distribution is over the Internet, space limitations imposed by both free and paid Internet providers requires the number of images of maps or photographs be kept to a minimum or transmitted at low resolutions. Either choice downgrades the quality of provided information. As long as individuals provide access to this information, relying on free or inexpensive web space, there will be limitations on just how much information can be available over the Internet. Once the military, educational, or historical institutions take interest in providing disk space for this type information, digital atlases will truly be able to come into their own.

CHAPTER 2

2. Contents of the of Iwo Jima Interactive Digital Atlas

The thesis CD-ROM contains 5042 files, which includes 3148 individual web pages, 45 scanned raster maps, 36 new raster maps created from the Iwo Jima GIS, 35 new PDF maps created from the Iwo Jima GIS, 35 PDF files containing the daily summary portions of the individual units after action reports, 35 HTML pages containing a raster map showing the progress of the front lines for each day, and all regimental daily summaries for the corresponding day of fighting, and all the files necessary to combine them into a single interactive digital atlas. All these files are instantly available within 5 clicks of a mouse from the main page of the interface. In addition to the atlas there are three books in PDF format, which illustrate three different levels of descriptions of the battle of Iwo Jima. Two of these references, “Uncommon Valor”, and the “U. S. Marines on Iwo Jima” represent the level of historical and geographical detail available to most readers prior to the compilation of this interactive digital atlas. The remaining reference is the daily summaries of the 3rd Marine Division and its infantry units “Third Marine Division on Iwo Jima”.

2.1 New Maps in the Iwo Jima Interactive Digital Atlas

The Iwo Jima Digital Atlas includes 71 maps created from the Iwo Jima GIS. These maps are divided into three categories, raster maps, interactive maps, and printable maps.

2.1.1 Raster Maps Created from the Iwo Jima GIS

The interactive digital atlas contains three new raster maps (scans of the maps published from the Iwo Jima GIS). The first represents the island and its defenses at the time of the battle (February-March, 1945). The remaining two maps contain a combination of details from 1945 and 1948 overlaid on a map of Iwo Jima today. The difference between these two maps is that one has UTM grid lines for spatial reference, and the other has the target square reference system used during the battle. The maps must be examined with Mr. Sid Viewer. When opened, they are first presented in a small window. The cursor can be used to click and drag a box to zoom into a specific area. Controls along the right edge can zoom in or out and move the view up or down; the control along the bottom edges can be used to move the view left and right.

2.1.2 Interactive HTML Maps in the Iwo Jima Interactive Digital Atlas

The Iwo Jima interactive digital atlas contains two interactive maps, one for northern Iwo Jima, and one for southern, with an overlap area between. Clicking on a red symbol within HTML atlas sheets displays a description of the symbol. Clicking on a blue dot displays a copy of a Medal of Honor citation describing a heroic action that occurred at the dot location. Clicking on a magenta dot presents a photograph of the represented defensive installation or event that took place at the dot location. Clicking elsewhere on the island brings up a HTML file describing the fighting that took place on the day that the piece of ground, represented by the selected polygon, was captured. The type of description depends on the zoom level of the view. Division reports are linked to

the 100% view, regimental reports are linked to the 200% view, and battalion reports are linked to the 400% view. A link to the symbol legend is at the screen bottom.

2.1.3 Printable Maps in the Iwo Jima Interactive Digital Atlas

I call these printable maps, because of their convenient size, 8½ x 11 inches. They can be duplicated on any printer. I have placed them in this category because printing the other scanned maps at full size would require a large format printer or a plotter. There are 35 printable maps in the Iwo Jima interactive digital atlas. These maps display the locations of the US units and front lines for each day of the battle.

2.2 Scanned Source Maps in the Iwo Jima Interactive Digital Atlas

The interactive digital atlas contains 21 scans of original maps published before, during, and after the invasion of Iwo Jima. The only way I could duplicate this information at the Marine Corps Museum in Washington, D.C. was to manually photograph them in pieces. When I did so, my camera was not aligned absolutely perpendicular to the maps. Later when the photos were joined together some lines failed to align perfectly across interior edges of the composite photographs. In addition, areas along some edges were not photographed owing to time limitations. Scanned source maps also require the Mr. Sid Viewer.

2.3 Photo Albums in the Iwo Jima Interactive Digital Atlas

All photo albums are in HTML format, and there is one album for each source

from which photographs were scanned. Each photo album contains all photos derived from a single source, usually a document, used in the Atlas. When an album is selected, thumbnail images of its photos appear on the computer screen. Simply scroll down the thumbnails, click on any one, and a web page based on that photo opens in the right frame of the page. Information provided with each photo typically includes the source document or book, author, publisher, name of the photo on the CD-ROM, and date of either the publication or the date the photo album was created.

2.4 Daily Summaries in the Iwo Jima Interactive Digital Atlas

Daily summaries reviewed each day's activities of each unit at the division, regimental and battalion levels. They were prepared by the unit commanders. These reports contain such information as what the plan of attack for the day was, a description of the fighting, and casualties. The division level reports are in an HTML format, which allows users to select a division, then a calendar day, which then links to that division's summary. The regimental and battalion level reports are presented in PDF format. The choice of different formats was to demonstrate different ways of presenting this information.

2.5 Medal of Honor Recipients in the Iwo Jima Interactive Digital Atlas

The Medal of Honor is the nation's highest military award given for bravery above and beyond the call of duty. Twenty-seven men received the Medal of Honor for their actions during the battle for Iwo Jima. The digital interface lists the name of each Medal of Honor recipient, each of which is linked to a web page that displays the official

Medal of Honor citation for the individual. The HTML page that is opened from this interface is the same page called from the interactive atlas sheets.

2.6 Out of Print/E-Books in the Iwo Jima Interactive Digital Atlas

This interface links to three digital books on the battle of Iwo Jima. They are included so that readers can review examples of books published on this battle. These books are presented in PDF format. A book will open upon selection of its title.

2.7 Viewing the Iwo Jima Interactive Digital Atlas

Even for the novice computer user, no new computer skills are necessary to view the Iwo Jima interactive digital atlas. The skills required are the same necessary to operate any windows-based program, simply point and click to navigate through the atlas.

As already noted, there is no need to purchase software to view this interactive digital atlas. Copies of needed software are archived on the CD-ROM for users without Internet access. If computers do not already have Adobe Acrobat Reader or Mr. Sid Viewer, users will want to go to the “read me first” page for instructions to install these two software packages. Once these two software packages are installed, simply place the CD-ROM into the CD-ROM drive of a computer. Unless the CD-ROM autorun feature is turned off, the CD-ROM will start automatically. If autorun is turned off, navigate to the root directory on the CD-ROM and double click on the file "launch.exe".

CHAPTER 3

3. Making the Iwo Jima Interactive Digital Atlas

The production of the interactive digital atlas of Iwo Jima spanned a time when GIS software and GIS viewing software improved greatly. Initially there was no practical method available to distribute the GIS products to non-GIS users. Products for viewing GIS data, such as ESRI's ArcExplorer, currently available were, and are still, crippled versions of the vendors' major commercial software. However, one company in Germany, Alta4, came up with a solution to this problem. They developed software in the form of an ArcView extension that creates HTML pages with hyperlinks based on attributes attached to the points, lines, or polygons of GIS layers. This software package was pivotal in the completion of this thesis because it converted the proprietary file formats into formats that could be easily distributed over the Internet or on CD-ROM.

3.1 Software Used to Create the Iwo Jima Interactive Digital Atlas

The following software packages were used to produce the Iwo Jima interactive digital atlas²:

ArcInfo – This package produced by ESRI of Redlands, CA, was used to produce all digital data, compose and rasterize the map composition, and register the map image back to the GIS data used to create it.

² Values following text refer to location on work flow diagram (Figure 1). Arrows represent moving from one process to another

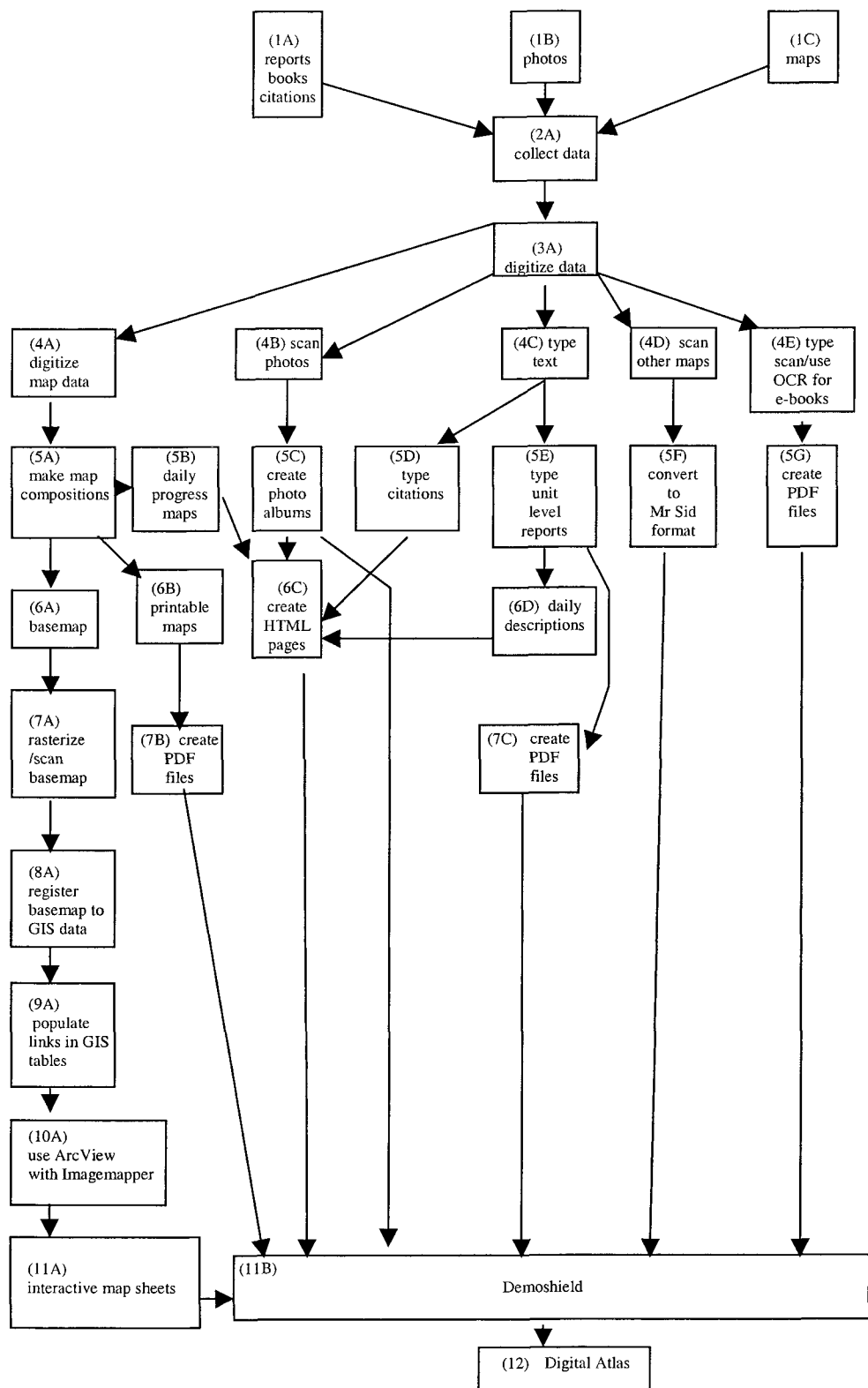
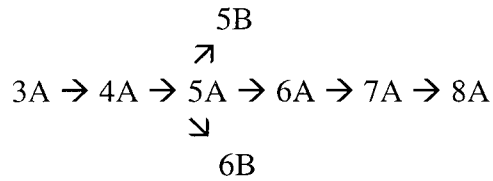


Figure 1: Work Flow Diagram



ArcView – This software package, also produced by ESRI, was used to combine the digital map image with appropriate themes that contain the paths to and names of links and to prepare the final interactive HTML maps of the atlas (9A).

Imagemapper - This ArcView extension, produced by Alta4 in Germany, was used to create the interactive HTML maps for the digital atlas. It creates the directory structure, map images, links, and final web page image maps. A demo version of this extension with limited capabilities is available free over the Internet (10A).

Adobe Photoshop - This software package was used to insert captions on each scanned photo. The Tiff file format allows text to be embedded into images as photo captions or credits. These photos and captions were then used to create individual web pages and the photo album interface to view each photo (4B → 4C).

Adobe Acrobat - One portion (Adobe Distiller) of this software was used to create the printable map sheets in PDF format from the postscript files created from ArcInfo map compositions. The printable map sheets are individual PDF maps that show the progress for each day of the fighting along with individual unit locations on Iwo Jima (5E → 7B, 6B → 7B, 4D → 5G).

Demoshield - This software was used to create the interface for final CD. It

creates a self-contained demonstration CD-ROM. In this case it created the Iwo Jima interactive digital atlas (11B → 12).

3.2 Automated Procedures Used to Create Digital Maps in the Iwo Jima Interactive Digital Atlas

Many map-making procedures were automated by writing software macros. These macros were simply lists of commands that the software followed to create the final maps; they permitted repetitious running of procedures with minimal operator intervention. Within ArcInfo all macros (AML's) used to produce the various maps in the Iwo Jima interactive digital atlas were variations of one grand AML, which was written to produce the printed map of Iwo Jima. This AML is included in Appendix 2. By changing parameters or elements in a macro such as sheet size, scale, and coverage, it was simple to make modifications on an AML to produce a map that in no way resembled the one produced by the original AML.

3.2.1 Creating the Printable Maps

By creating an AML that cycles through another AML, which, in turn, generates a single map, and by incorporating a few variables to change key parameters or elements, I was able to produce a series of 35 maps, each representing the situation for one day of the battle (5A → 6B). Once this AML started, it created a map composition and a postscript file for each of the 35 maps. When this AML finished running, I ran Adobe Acrobat Distiller, using the watched folder option, and all 35 PDF files of the maps were created with no further operator intervention (7B). The entire production of 35 different PDF

maps involved running one AML followed by Adobe Acrobat Distiller.

3.2.2 Creating the Photo Album Pages

In addition to the web pages created by Imagemapper, individual web pages of all photos linked within image maps were created in Adobe Photoshop (5C). Photoshop with its photo album option automated creation of these web pages. The photo albums created by Photoshop are web-page-based versions of traditional photo albums. These photo albums are scrollable collections of thumbnail images with links to the individual HTML page for each photo. The process of creating these is covered in the Photoshop help documents.

3.2.3 Creating the Interactive HTML Maps

The production of interactive HTML pages was also nearly automated (10A → 11A). The only operator actions needed to produce those maps were to (1) create a view in ArcView with the desired themes, (2) set the options in the Imagemapper software, and (3) start the process. Imagemapper then produced all the HTML pages and images for the maps, set up the required links, and created the necessary directory structure to organize the new files.

3.3.4 Production of the Iwo Jima interactive Digital Atlas

Each element of the digital atlas was created as I found a software package with an output suitable for my digital atlas. Because these were not created in a set order, I have included the work flow diagram (Figure 1) that illustrates all the different aspects of creating the Iwo Jima Digital Atlas. As I stated above, most aspects of the creation are included in the individual software help documents. Only a few aspects of creating the interactive digital atlas sheets need to be

discussed further to clarify them.

Symbolization of the Base Map.-- Because the interactive HTML atlas sheets were done in ArcView, symbolizing many of the elements for the basemap would have been either more work than necessary or very difficult to do. Some potential difficulties to face were (1) re-creating the ArcInfo marker set (point symbols) again so they can be used in ArcView, (2) re-creating the line set (line symbols) for ArcView, (3) re-creating all text layers, so they can be properly displayed in ArcView, and (4) dealing with ArcView's limited capability to symbolize roads (two layers overlaid on each other) adequately. Even with items 1-4 adequately resolved, 40 separate layers would be needed to build the basemap, whereas with either a raster map created in ArcInfo or a scanned copy of the printed map only one additional layer was necessary. To avoid problems 1 - 4, I scanned and registered the printed map. By doing so I reduced the number of layers in the ArcView view from 40 to 4 plus the scanned and registered map.

Relative Paths.-- Every object (point, line, or polygon) within the Iwo Jima GIS that was to be linked to an external file contained a path to that file. In order for the CD-ROM to be independent of a specific drive path, this path had to be relative, indicating no specific drive in the file path, for example, ".././photos/file.htm" for a web page. Using an HTML file as an example, the relative path does not designate the drive or the specific path containing the image file located in the photos directory, but the relative location of this file to the current directory location.

Modified Zoom Levels.-- To show the advance of the battle across Iwo

Jima, I created a coverage called “progress”. This ArcInfo coverage detailed the extent of ground captured every day by the U.S. Marines. In order to link to 3 different web pages for each polygon based on zoom level (because Imagemappper only allows 2), I had to create one atlas sheet with the 100% zoom level linked to the division reports, and all other zoom levels linked to the regimental level reports. After doing this I created an identical atlas sheet with all other levels of zoom linked to the battalion level reports. Following the creation of these two identical sheets, I took the 400% level zoom files (all files with 400 in title) from the second sheet, and put them back into the first atlas sheet (directory), replacing those identically named pages. By doing this, I expanded the capabilities of the Imagemappper software to 4 different attributes, images, or text documents per theme, or a potential total of 20 different categories of links per atlas sheet.

3.3.5 Creating the Final Interactive Digital Atlas Interface

While I created the final interface (12) with Demoshield, it could have been prepared as easily with any HTML editor currently on the market. I chose Demoshield because it simplified the process of creating a CD-ROM that will autostart when inserted into a computer.

CHAPTER 4

4.0 Discussion and Summary

Access to information about the battle for Iwo Jima has been restricted for more than 50 years to individuals with the means to research the original documents. During this period those with access made no significant attempt to satisfy the needs of a significantly large segment of today's general public. Today, GIS technology gives us the ability to link together digital copies of these historic records into a geographically referenced set of data.

When I embarked on the Iwo Jima project, there was no easy or cost-free way to disseminate the finished GIS product. I spent almost 3 years working around current options before finding a practical solution. Here I have presented what I believe to be a sound prototype of an interactive digital atlas, developed on methods and concepts that could be applied as well to many additional historic battles of the United States military.

I have provided a basic outline of how I constructed my digital atlas, along with a sample work flow diagram to assist others in creating their digital atlases. This is not the only way to create a digital atlas, but the way I created this one. Software advances will eventually make my methods obsolete; however, with these advances will come more efficient methods of replicating and distributing these historic records to the public.

4.1 GIS as a Tool

Using GIS to make an interactive digital atlas offered several advantages over other methods: (1) GIS data and methods effected exact replication of detail from map to map; (2) Writing macros for digital map production within a GIS environment allowed

for unlimited variations of the same base map to be readily produced; and (3) By integrating GIS data and map products with other commercial software, their output was combined into a very detailed digital atlas, in this case the Iwo Jima interactive digital atlas.

4.2 Interactive Digital Atlas as a Medium

I developed this prototype with the following capabilities:

1. The Iwo Jima interactive digital atlas requires no specific software or computer skills to use. All software required to view the information on the CD-ROM either comes on any new PC or is available over the Internet for free. For those lacking Internet access, copies of the required software are archived on the CD-ROM. Once all required software packages are installed, any PC user with basic skills can easily access every aspect of this historic battle recorded on the CD-ROM.

2. The Iwo Jima interactive digital atlas combines spatial references with descriptions and photos, all available instantaneously to the user. This marks a significant advance in the presentation of historical military geography. This combination of information allows users to switch between maps showing a battle's geography to reports from the fighting units and then to reports of neighboring or relieving units to better grasp what transpired. Researchers need no longer organize or sort through stacks of reports and maps to find nearly complete battlefield information.

3. The Iwo Jima interactive digital atlas is interactive because of its 'hot

link' capability. This capability allows users to open digital documents describing aspects of the battle with a click of the mouse. No element of the atlas is more than 5 clicks away from the atlas startup page. By clicking on a menu item, point, line, or polygon representing an event or location on the map the user has access to information that has never been readily available to the public. This capability facilitates the easy navigation through the entire digital atlas.

4. The format of the Iwo Jima interactive digital atlas facilitates easy distribution. The high storage capacity and compact design of CD-ROMs enable huge amounts of information to be easily and cheaply distributed via mail to anyone anywhere in the world. Even with limits placed by Internet service providers, large amounts of the data can be distributed over the Internet, which provides access to these data 24 hours a day, 7 days a week.

5. The Iwo Jima interactive digital atlas contains a level of detail never before made easily accessible to the public. This atlas portrays for the first time in great detail an extraordinary, significant and heroic event, the battle of Iwo Jima, in the documents, words, maps, and photographs of the men who fought there. In the nearly 60 years since the battle for Iwo Jima, not a single publication has presented to the general public as much detailed information on this or any other WW II battle. This digital atlas stands unique in this aspect.

6. Today's society has come to expect, and finds instantaneous access to, a wide variety of topics via the Internet. Technology has progressed to the point where we no longer have to accept the published generalized accounts of our past wars as the standards by which we evaluate modern accounts of these historic

battles. Computer technology gives us the ability to store and distribute these records digitally. GIS gives the ability to associate these records to each other and to a spatial reference. However, because GIS file formats and software are ill-suited for data distribution to the general public, they must be converted to other formats for distribution. Once these files are converted, they can be easily combined into an interactive digital atlas. In this form every type of recorded detail on any historic battle can be captured and distributed to anyone anywhere in the world. The Iwo Jima interactive digital atlas provides an example of battlefield reconstruction that is in tune with today's technology. It demonstrates that GIS has the capacity to carry battlefield historical geography forward into the technology of tomorrow. And in so doing, it attains a level of detail expressed in the words of those who fought there.

4.3 Summary

What I have assembled here in the form of a digital atlas exceeds in level of detail any published account of any historic battlefield in any medium available to the general public. The battle for Iwo Jima was the most costly battle the Marine Corps fought in WW II. Out of this battle came the icon that will represent the Marine Corps forever, the second flag raising on Mt. Suribachi. This photograph captured the attention of American public even before the battle was over. It was featured on the 7th War Bond poster, published on a stamp, and was the inspiration for the Marine Corps War Memorial near Arlington National Cemetery. The battle for Iwo Jima has been written about since 1945, and new books are still being published on this historic battle. In the last 3 years,

there have been at least 2 books published and 3 hours of new documentaries for the History Channel dedicated to this battle. As important as this battle was in the Pacific and to the Marine Corps, and despite all that has been written and produced on film on this specific battle, the information contained in this thesis has never been available to the public. What I have here is what I hope to be the first of many digital accounts of our historic battles our men in uniform have fought through the years. These digital accounts will make the details of these historic accomplishments available in the words, maps and photographs of those who fought the battles to future generations long after those who fought them are gone.

APPENDIX 1

DOCUMENTS USED TO CREATE

THE IWO JIMA INTERACTIVE DIGITAL ATLAS

MAPS

"Anti-Aircraft Defenses", JICPOA, date unknown 1:20,000. Map Collection, United States Army Military History Institute, Carlisle, Pennsylvania

"Blockhouses", JICPOA, date unknown, 1:20,000. Map Collection, United States Army Military History Institute, Carlisle, Pennsylvania

"Covered Artillery", JICPOA, date unknown, 1:20,000. Map Collection, United States Army Military History Institute, Carlisle, Pennsylvania

Enclosure (B) To 3rd Marine Division After Action Report (contains 27 maps), an unpublished manuscript. Map Collection, Marine Corps Museum, Washington D. C.

"Enemy Installation Map Iwo Jima", 3 sheets, 10 February 1945, no publication credits given on map. Map Collection, Marine Corps Museum, Washington D. C.

"Enemy Defense Installations, as observed from ground study 19 February - 19 March, 1945". Map Collection, United States Army Military History Institute, Carlisle, Pennsylvania

"Mine Situation Map of Iwo Jima", Corps Engineer Section, V Amphibious Corps, 16 March, 1945, 1:20,000. Map Collection, Marine Corps Museum, Washington D. C.

"Special Air and Gunnery Target Map", 64th Engineer Topographical Battalion, Nov 1944, 1:10,000. Map Collection, Marine Corps Museum, Washington D. C.

"Special Map Iwo Jima" Series W811, Edition 1-AMS, 34th Engineer Base Photomapping Company, 1948, 1:12,500. Map Collection, Marine Corps Museum, Washington D. C.

"Special Map Iwo Jima", Series W811, Edition 3-AMS, 29th Engineer Battalion, March 1985, 1:12,500.

UNPUBLISHED MANUSCRIPTS

(Arranged by unit)

Headquarters 3d Marine Division, Fleet Marine Force, "War Diary", 28 April 1945.
Special Collections, Marine Corps Museum, Washington D. C.

Headquarters 3d Marine Division, Fleet Marine Force, "Action Report, IWO JIMA
Operation", 30 April, 1945. Special Collections, Marine Corps Museum,
Washington D. C.

CO, 9th Marine Regiment, "Action Report, IWO JIMA", 20 April, 1945. Special
Collections, Marine Corps University, Quantico, Virginia

CO, 1st Battalion, 9th Marine Regiment, "Action Report, Iwo Jima", 18 April, 1945.
Special Collections, Marine Corps University, Quantico, Virginia

CO, 2d Battalion, 9th Marine Regiment, ", Action Report, IWO JIMA", 19 April, 1945.
Special Collections, Marine Corps University, Quantico, Virginia

CO, 3d Battalion, 9th Marine Regiment, "Action Report, IWO JIMA", 20 April, 1945.
Special Collections, Marine Corps University, Quantico, Virginia

CO, 21st Marine Regiment, "Action Report, IWO JIMA Operation", 10 April, 1945.
Special Collections, Marine Corps University, Quantico, Virginia

CO, 1st Battalion, 21st Marine Regiment, "Action Report", 6 April, 1945. Special
Collections, Marine Corps University, Quantico, Virginia

CO, 2d Battalion, 21st Marine Regiment, "Action Report, Iwo Jima Operation", 12 April,
1945. Special Collections, Marine Corps University, Quantico, Virginia

CO, 3d Battalion, 21st Marine Regiment, "Action Report", 11 April, 1945. Special
Collections, Marine Corps University, Quantico, Virginia

"G-2 Periodic Reports, 4th Marine Division, Fleet Marine Force 19 February to 16
March, 1945", Special Collections, Marine Corps University, Quantico, Virginia

CO, 23rd Marine Regiment, "Operation Report (Iwo Jima)", 9 April, 1945. Special
Collections, Marine Corps University, Quantico, Virginia

CO, 1st Battalion, 23d Marine Regiment, "Annex FOX to RCT 23 Operation Report (Iwo
Jima), BLT 1/23 Operation Report", undated. Special Collections, Marine Corps
University, Quantico, Virginia

CO, 2d Battalion, 23d Marine Regiment, "Annex George to RCT 23 Operation Report (Iwo Jima), Battalion Landing Team 2/23 Operation Report (Iwo Jima), undated. Special Collections, Marine Corps University, Quantico, Virginia

CO, 3d Battalion, 23d Marine Regiment, "Appendix 8 to Annex Fox", 12 April, 1945. Special Collections, Marine Corps University, Quantico, Virginia

CO, 24th Marine Regiment, "Final Report on IWO JIMA Operation", 20 April, 1945. Special Collections, Marine Corps University, Quantico, Virginia

CO, 1st Battalion, 24th Marine Regiment, "Final Report on IWO JIMA Operation", 20 April 1945. Special Collections, Marine Corps University, Quantico, Virginia

CO, 2d Battalion, 24th Marine Regiment, "Final Report on IWO JIMA Operation", 19 April 1945. Special Collections, Marine Corps University, Quantico, Virginia

CO, 3d Battalion, 24th Marine Regiment, "Final Report on IWO JIMA Operation", 20 April, 1945. Special Collections, Marine Corps University, Quantico, Virginia

CO, 25th Marine Regiment, "Annex HOW to Fourth Marine Division Operations Report, Iwo Jima, RCT 25 Report", 15 April, 1945. Special Collections, Marine Corps University, Quantico, Virginia

CO, 1st Battalion, 25th Marine Regiment, "BLT #1, RCT 25 Operation Report, Iwo Jima, Volcano Islands", undated. Special Collections, Marine Corps University, Quantico, Virginia

CO, 2d Battalion, 25th Marine Regiment, "Appendix VII to RCT - 25 Operations Report, Iwo Jima, Volcano Islands BLT - 2/25 Operations Report: 16 April, 1945. Special Collections, Marine Corps University, Quantico, Virginia

CO, 3d Battalion, 25th, Marine Regiment, "Appendix 8 to Annex HOW to Fourth Marine Division Operation Report, Iwo Jima, Volcano Islands. BLT-3 RCT -25 Operation Report, Iwo Jima, Volcano Islands", undated. Special Collections, Marine Corps University, Quantico, Virginia

"5th Marine Division Daily Summary Reports 19 February to 24 March, 1945", Special Collections, Marine Corps Museum, Washington D.C.

CO, 26th Marine Regiment, "Action Report on IWO JIMA Operation", 20 April, 1945. Special Collections, Marine Corps University, Quantico, Virginia

CO, 1st Battalion, 26th Marine Regiment, "Action Report on Iwo Jima Operation, 19 April, 1945. Special Collections, Marine Corps University, Quantico, Virginia

CO, 2d Battalion, 26th Marine Regiment, "Action Report on Iwo Jima Operation, 19 February, 1945 to 27 March, 1945", 18 April, 1945. Special Collections, Marine Corps University, Quantico, Virginia

CO, 3d Battalion, 26th Marine Regiment, "Action Report on IWO JIMA Operation, 19 February 1945 to 26 March 1945", 19 April, 1945. Special Collections, Marine Corps University, Quantico, Virginia

CO, 27th Marine Regiment, "Annex ROGER (CT-27 Action Report) to 5th Mar Div Action Report, Iwo Jima Operation", 18 April, 1945. Special Collections, Marine Corps University, Quantico, Virginia

CO, 1st Battalion, 27th Marine Regiment, "Enclosure (E) (BLT 1/27) to Annex ROGER", 17 April, 1945. Special Collections, Marine Corps University, Quantico, Virginia

CO, 2d Battalion, 27th Marine Regiment, "Enclosure (F) (BLT 2/27) to Annex ROGER", 17 April, 1945. Special Collections, Marine Corps University, Quantico, Virginia

CO, 3d Battalion, 27th Marine Regiment, "Enclosure (G) (BLT 3/27) to Annex ROGER", 10 April 1945. Special Collections, Marine Corps University, Quantico, Virginia

CO, 28th Marine Regiment, "Action Report CT-28 Iwo Jima Operation 19 Feb. 1945 To 26 Mar. 1945", undated. Special Collections, Marine Corps University, Quantico, Virginia

CO, 1st Battalion, 28th Marine Regiment, "Action Report Landing Team 128 Iwo Jima Operation 19 February, 1945 to 26 March, 1945", undated. Special Collections, Marine Corps University, Quantico, Virginia

CO, 2d Battalion, 28th Marine Regiment, "Action Report Landing Team 228 Iwo Jima Operation 19 February, 1945 to 26 March, 1945", 10 April, 1945. Special Collections, Marine Corps University, Quantico, Virginia

CO, 3d Battalion, 28th Marine Regiment, "Action Report Landing Team 328 Iwo Jima Operation 19 February, 1945 to 26 March, 1945", undated. Special Collections, Marine Corps University, Quantico, Virginia

UNPUBLISHED REPORTS

Headquarters, Fleet Marine Corps Force Pacific, "Naval Gunfire Support, Expeditionary Troops Report, ", 16 June 1945. Special Collections, Marine Corps University, Quantico, Virginia

Headquarters, Fleet Marine Corps Force Pacific, "A Photographic Study of Japanese Ground Installations Iwo Jima" undated. Special Collections, Marine Corps University, Quantico, Virginia

"Iwo Jima Preliminary Bombardment, A Photographic Study", no originating agency, undated. Special Collections, Marine Corps University, Quantico, Virginia

United States Fleet, Headquarters of the Commander in Chief, "Amphibious Operations, Capture of Iwo Jima, 16 February to 16 March 1945", July 1945, Special Collections, United States Army Military History Institute, Carlisle, Pennsylvania

United States Pacific Fleet, "Defense Installations on Iwo Jima", June 1945, Special Collections, United States Army Military History Institute, Carlisle, Pennsylvania

BOOKS

Aurthur, Robert A, First Lieutenant, USMCR. Cohlma, Kenneth, First Lieutenant, USMCR, and Vance, Robert T. Lieutenant Colonel, USMC. *The Third Marine Division*. Infantry Journal Press, Washington, 1948.

Bartley, Whitman S. Lieutenant Colonel, USMC. *Iwo Jima: Amphibious Epic*. Historical Branch, G-3 Division, Headquarters, U.S. Marine Corps, 1954

Conner, Howard M. *The Spearhead, the World War II history of the Fifth Marine Division*. Infantry Journal Press, Washington, 1950.

Proehl, Carl W. *The Fourth Marine Division in World War II*. Infantry Journal Press, Washington, 1946

APPENDIX 2

AML TO AUTOMATE CREATION OF THE 1:12,000 IWO JIMA MAP

/* This AML will produce a 1:12000 scale map of Iwo Jima.
/* It requires a custom line and marker set, and will not function
/* without them.
/* Written by Raymond C Backstrom, August 2001

```
display 9999 1
ap
weeddraw off
&if [exists iwomap.map -directory] &then killmap iwomap.map
mapextent margin_gnd
pagesize 24.5 36.5
box 0 0 24 36
maplimits 0 0 24 36
mapposition cen 12 17.79
mapunits meters
mapscale 12000
map iwomap.map
textset mapfin.txt
lineset symbol.lin
shadeset symbols.shd
markerset symbols_25
polygonshades ocean symbol
polygonshades bc symbol
arclines rds_45 symbol
arclines rds_45 symbol2
linesymbol 565
linesymbol 472
polygonshades airflds453 symbol
linesymbol 491
arcs big_nos
arcs outline
linesymbol 285
arcs grid1000
annotext grid1000 igds
arcs compass
arcs grid100
linesymbol 494
arclines cont45 symbol
arclines terrace symbol
annotext cont45
linesymbol 328
```

```

arcs def_legend
pointmarkers def_legend symbol
arcs airflds452
arcs beaches
arcs def_gnd
arcs margin_gnd
arcs samplegrid
linesymbol 410
arcs isle_45
polygonshades bldgs_45 61
markersize .01
pointmarkers cave symbol
pointmarkers def_gnd symbol
annotext def_legend igds
pointmarkers long symbol
annotext long
annotext samplegrid igds
pointmarkers arfld452_p symbol
textsymbols 2
annotext margin_gnd
annotext margin_gnd igds
annotext def_gnd igds
annotext compass igds
annotext cave
annotext beaches igds
annotext smallnos igds
arclines smallnos symbol
pointmarkers ddaybn symbol
arclines totaldday symbol

/* Create the Postscript files
q
&if [exists iwomap.ps -file] &then &sys rm iwomap.ps
postscript iwomap.map iwomap.ps 1.00 pdf.prm

```

APPENDIX 3

LIST OF ABBREVIATIONS USED IN REPORTS

12thMar	12th Marine Regiment
13thMar	13th Marine Regiment
14thMar	14th Marine Regiment
1stBn	1st Battalion
1stJASCO	1st Joint Assault Company
1stLt	1st Lieutenant
1stPl	1st Platoon
1stPlat	1st Platoon
1stSec	1st Section
2dBn	2nd Battalion
2dLt	2nd Lieutenant
2ndArmdAmph	2nd Armored Amphibious
2ndBn	2nd Battalion
30thReplDrft	30th Replacement Draft
3dBn	3rd Battalion
3dMarDiv	3rd Marine Division
3dMedBn	3rd Medical Battalion
3dSec	3rd Section
3rdProv	3rd Provisional Battalion
4thEngrBn	4th Engineer Battalion

4thMarDiv	4th Marine Division
4thMedBn	4th Medical Battalion
4thPnrBn	4th Pioneer Battalion
4thPionBn	4th Pioneer Battalion
4thTkBn	4th Tank Battalion
5thEngrBn	5th Engineer Battalion
5thMarDiv	5th Marine Division
5thMedBn	5th Medical Battalion
5thPioneerBn	5th Pioneer Battalion
5thTankBn	5th Tank Battalion
9thMar	9th Marine Regiment
ADC	Assistant Division Commander
AKN	Net Cargo Ship
AMS	Army Map Service; Minesweeper, High Speed
APA	Transport, Attack
APC	Armored Personnel Carrier
APD	Transport, High Speed
APS	Transport, Submarine
ARG	Repair Ship, Internal Combustion Engine
ARL	Repair Ship, Landing Craft
ARS	Salvage vessel
AT	Anti-Tank
Amph	Amphibious

AmphTrac	Amphibious Tractor
AmphTracBn	Amphibious Tractor Battalion
AmphTruckCo	Amphibious Truck Company
Amphib	Amphibious
ArmdAmphTracBn	Armored Amphibious Tractor Battalion
Amtrac	Amphibious Tractor
Arm'd	Armored
Asst	Assistant
Atch	Attached
Atchd	Attached
Atk	Attack
BAR	Browning Automatic Rifle
BARman	Browning Automatic Rifleman
BARmen	Browning Automatic Riflemen
BB's	Battleships
BLT	Battalion Landing Team
Bn	Battalion
BnHq	Battalion Headquarters
BnHqCo	Battalion Headquarters Company
Btry	Battery
C.O.	Commanding Officer
C.P.	Command Post
CINCPAC	Commander-in-Chief, US Pacific Fleet

CINCPOA	Commander-in-Chief, Pacific Ocean Area
CO's	Commanding Officers
COCT26	Commanding Officer Combat Team 26 (Commanding Officer 26th Marine Regiment)
CollSec	Collection Section
CP	Command Post
CPX	Command Post Exercise
CR	Cross Road
CT25	Combat Team 25 (25th Marine Regiment)
CT26	Combat Team 26 (26th Marine Regiment)
CTF	Commander Task Element
CTG	Commander Task Group
CVE	Aircraft Carrier, Escort
CVL	Aircraft Carrier, Small
Capt	Captain
CinPhibsPac	Commander-in-Chief, Amphibious Forces, US Pacific Fleet
CinCPac	Commander-in-Chief, US Pacific Fleet
CinCPoa	Commander-in-Chief, Pacific Ocean Area
Co's	Commanding Officers
Col	Colonel
Comdg	Commanding
Comdr	Commander
Cpl	Corporal
DP	Dual Purpose

DUKW	Amphibious Truck
DWIA	Died of wounds resulting from action with enemy
Demo	Demolitions
Det	Detachment
Divs	Divisions
EC	East Central
EFF	Effective
EXPED	Expeditionary
Eng	Engineer
Engr	Engineer
EngrBn	Engineer Battalion
Enl	Enlisted
ExO	Executive Officer
F.D.C.	Fire Direction Center
F4U	“Wildcat”, single-engine Navy fighter (VF), manufactured by Grumman
F6F	“Hellcat”, single-engine Navy fighter (VF), manufactured by Grumman
FA	Field Artillery
FMF	Fleet Marine Force
FO	Forward Observer
Fd	Forward
Fld	Field
FldDep	Field Depot

FT	Flame Thrower
Frag	Fragmentation
GO	General Order
Grp	Group
H&S	Headquarters and Service
H&SCo	Headquarters and Service Company
H.C.	Hexachlorethane Mix (smoke shell)
H.E.	High Explosive
HB	Heavy Bomber
HM3	Hospitalman 3rd Class
HMG	Heavy Machine Gun
Hq	Headquarters
Hqs	Headquarters
Ind	Independent
Indep	Independent
Inf	Infantry
JASCO	Joint Assault Signal Company
JASCo	Joint Assault Signal Company
JICPOA	Joint Intelligence Center, Pacific Ocean Areas
Jasco	Joint Assault Signal Company
Jd	Joined
KIA	Killed in Action
LC	Landing Craft

LCI	Landing Craft Infantry
LCI(M)	Landing Craft, Infantry (Mortar Ship)
LCI(R)	Landing Craft, Infantry, (Rocket Ship)
LCM	Landing Craft Mechanized
LCP	Landing Craft, Personnel
LCS	Landing Craft, Support
LCT	Landing Craft, Tank
LCVP	Landing Craft Vehicle and Personnel
LD	Line of Departure
LMG	Light Machine Gun
LOD	Line of Departure
LSH	Landing Ship, Headquarters
LSM	Landing Ship, Medium
LST	Landing Ship, Tank
LSV	Landing Ship, Vehicle
LT	Lieutenant
LT128	Landing Team 128 (1st Battalion 28th Marine Regiment)
LVT	Landing Vehicle Tracked
LVTA	Landing Vehicle, Tracked (Armored) (Turret type)
Ldr	Leader
Ln	Liaison
LnO	Liaison Officer
Lt	Lieutenant

LtCol	Lieutenant Colonel
MG	Machine Gun
MIA	Missing in Action
MP	Military Police
MPCo	Military Police Company
Maj	Major
MajGen	Major General
MarDiv	Marine Division
Med	Medical
MedBn	Medical Battalion
Mort	Mortar
NCB	Navy Construction Battalion
NC	North Central
NCO	Non Commissioned Officers
NE	Northeast
NGF	Naval Gunfire
NW	Northwest
OFF	Officer
O.P.	Observation Post
OBB	Old Battleships
Opn	Operation
PB4Y	“Liberator”, four-engine Navy transport, seaplane, manufactured by Consolidated-Vultee

PFC	Private First Class
Ph	Pharmacists
Ph.M	Pharmacists Mate
PhM2	Pharmacists Mate 2nd Class
Phib	Amphibian; Amphibious
Pion	Pioneer
PionBn	Pioneer Battalion
Pl	Platoon
Plt	Platoon
Prov	Provisional
Pvt	Private
QM	Quartermaster
RCT	Regimental Combat Team
RCT21	Regimental Combat Team 21 (21st Marine Regiment)
RCT23	Regimental Combat Team 23 (23rd Marine Regiment)
RJ	Road Junction
RLT	Regimental Landing Team
RRL	Regimental Reserve Line
R/Wpns	Regimental Weapons
Rcn	Reconnaissance
Recon	Reconnaissance
Reg	Regiment
Regt	Regiment

Regtl	Regimental
Reinf	Reinforced
Repl	Replacement
Res	Reserve
SC	South Central
SE	Southeast
SW	Southwest
SFCP	Shore Fire Control Party
SK&E	Sick and Evacuated
SOP's	Standard Operating Procedures
Secs	Sections
Ser	Service
Serv	Service
Sgt	Sergeant
Spt	support
T.S.	Target Square
TA	Target Area
TBM	"Avenger", single-engine Navy torpedo-bomber, manufactured by General Motors
TF	Task Force
TRS	Troops
Tgtlist	Target List
Tk	Tank

Tng	Training
Trac	Tractor
U.S.S.	United States Ship
UDT	Underwater Demolitions Team
USMC	United States Marine Corps
USMCR	United States Marine Corps Reserve
USN	United States Navy
USS	United States Ship
VAC	Fifth Amphibious Corps
VMO	Marine Observation Squadron
W&E	Wounded and Evacuated
W&NE	Wounded and not Evacuated
WC	West Central
WIA	Wounded In Action
WO	Warrant Officer
Wpn	Weapons
Wpns	Weapons
WpnsCo	Weapons Company
ZofA	Zone of Action
aa	Anti Aircraft
approx	approximately
atchd	attached
atk	attack

attchd	attached
btrys	battery's
evac	evacuated
rcn	reconnaissance
reinf	reinforced
sqd	squad
yds	yards

For those abbreviations used in the after action reports and not listed here, I was unable to find a period reference.